MA 3610
Topology, Fractals, and Chaotic Dynamics
Syllabus

Texts:
1) Nonlinear Dynamics and Chaos, Steven H. Strogatz, Addison-Wesley, 1994.
2) Interactive Di®erential Equations, Beverly West, Steven Strogatz, Jean Marie McDill, John Cantwell, Addison Wesley, 1997.

MA 3610 is a ¯rst course in nonlinear dynamics and chaos. Emphasizing one and two-dimensional °ows, and chaos, the course will concentrate on the qualitative study of dynamical systems by using geometrical methods.
A tentative course syllabus follows.

Lecture	Section	Topics
1	1.0,1.1,1.2,1.3	Overview
2	2.0,2.1,2.2	Geometric methods, ¯xed points, and stability
3	2.3,2.4	Population growth, linear stability analysis
4	2.5,2.6,2.7	Existence and uniqueness, non-oscillation, potentials
5	2.8,3.0,3.1	Computer sol., intro. to bifurcations, saddle-node bifurc.
6	3.1, 3.2	Saddle-node and transcritical bifurcation
7	3.4	Pitchfork bifurcation
8	3.5	Overdamped bead on a rotating hoop
9	5.0,5.1	Overdamped pendulum, linear systems: de¯nitions and examples
10	5.2	Classi¯cation of linear systems
11	5.3,6.0,6.1	Love a®airs, phase plane, phase portraits
12	6.2,6.3	Existence, uniqueness, topological conseq., ¯xed points, linearization
13	6.3,6.4	Fixed points, rabbits versus sheep
14	6.5	Conservative systems
15	6.6	Reversible systems
16	6.7	Pendulum
17	6.8	Index Theory
18	7.0,7.1	Limit cycles, examples
19	7.2	Ruling out closed orbits
20	7.3	Poincaré{Bendixson Theorem
21	8.0,8.1	Bifurcations: saddle{node, transcritical, and pitchfork
22	8.2	Hopf bifurcations
23	9.0, 9.1	Lorenz equations, a chaotic waterwheel
24	9.2	Simple properties of the Lorenz equations
25	9.3	Chaos on a strange attractor
26	9.4	Lorenz map
27	9.5	Exploring parameter space
28	10.0, 10.1	One dim. maps: ¯xed points and cobwebs
29	10.2, 10.3	Logistic map: numerics and analysis
30	10.3,10.4, 10.5	Periodic windows and Liapunov exponent
31	10.6	Universality and experiments

The tenative syllabus is a very full plate. The mathematics is not all that forbidding, but many of the ideas will be new, and at ¯rst may seem strange to you. For that reason (and for others too), it is important that you keep up with the reading in the text, meaning that you do the reading before we cover it in class, and that you devote much thought and e®ort to the assigned work.